AMENDMENTS TO THE CLAIMS

1. (Previously presented) An pose estimation system for performing object pose estimation by comparing an input image with a three-dimensional object model, the pose estimation system comprising:

an pose candidate decision unit for generating at least one pose candidate;

a comparison image generation unit for generating, according to the generated pose candidate, a plurality of comparison images close to the input image, while projecting the three-dimensional object model to a two-dimensional image;

a first sharpness extraction unit for extracting a first sharpness amount reflecting the sharpness from each of the plurality of comparison images;

a weighted difference calculator for calculating a plurality of weighted differences by weighting the first sharpness amount to the difference between the input image and each of the comparison images; and

a determination unit for selecting a comparison image having the smallest weighted difference among the plurality of weighted differences and estimating an optimal pose based on the selected comparison image.

2. (Original) The pose estimation system according to Claim 1, further comprising:

a second sharpness extraction unit for extracting a second sharpness amount reflecting the sharpness from the input image,

wherein the weighted difference calculator calculates a plurality of weighted differences by weighting the difference between the second sharpness amount of the input image and the first sharpness amount of each of the comparison images to the difference between the input image and the comparison image.

3. (Original) The pose estimation system according to Claim 1, wherein the weight becomes higher as the sharpness of the image becomes higher in the weighted difference calculation.

4. (Original) The pose estimation system according to Claim 2, wherein the first and second sharpness amounts are defined by a ratio of a number of pixels whose edge intensity is a threshold value or higher to the total number of pixels, a range of brightness values, dispersion of brightness values, or a number of characteristic points.

5. (Original) The pose estimation system according to Claim 2, wherein the first and second sharpness amounts are defined by an edge image or a characteristic point.

6. (Previously presented) An pose estimation and comparison system employing the pose estimation system according to Claim 1, wherein the determination unit further performs object comparison by comparing the minimum weighted difference of the estimated optimal pose with a predetermined threshold value.

7. (Previously presented) An pose estimation and comparison system employing the pose estimation system according to Claim 2, wherein the determination unit further performs object comparison by comparing the minimum weighted difference of the estimated optimal pose with a predetermined threshold value.

8. (Original) The pose estimation and comparison system according to Claim 6, wherein the weight becomes higher as the sharpness of the image becomes higher in the weighted difference calculation.

9. (Original) The pose estimation and comparison system according to Claim 7, wherein the first and second sharpness amounts are defined by a ratio of a number of pixels whose edge intensity is a threshold value or higher to the total number of pixels, a range of brightness values, dispersion of brightness values, or a number of characteristic points.

10. (Original) The pose estimation and comparison system according to Claim 7, wherein the first and second sharpness amounts are defined by an edge image or a characteristic point.

11. (Original) A comparison system for performing object comparison by comparing an input image with an object model, comprising:

a comparison image generation unit for generating a plurality of comparison images close to the input image from the object model;

a first sharpness extraction unit for extracting a first sharpness amount reflecting the sharpness from each of the plurality of comparison images;

a weighted difference calculator for calculating a plurality of weighted differences by weighting the first sharpness amount to the difference between the input image and each of the comparison images; and

a determination unit for performing object comparison by comparing the calculated plurality of weighted differences with a preset threshold value.

12. (Original) The comparison system according to Claim 11, further comprising:

a second sharpness extraction unit for extracting a second sharpness amount reflecting the sharpness from the input image;

wherein the weighted difference calculator calculates a plurality of weighted differences by weighting the difference between the second sharpness amount of the input image and the first sharpness amount of each of the comparison images to the difference between the input image and the comparison images.

13. (Original) The comparison system according to Claim 11, wherein the weight becomes higher as the sharpness of the image becomes higher in the weighted difference calculation.

14. (Original) The comparison system according to Claim 12, wherein the first and second sharpness amounts are defined by a ratio of a number of pixels whose edge intensity is a threshold value or higher to the total number of pixels, a range of brightness values, dispersion of brightness values, or a number of characteristic points.

15. (Original) The comparison system according to Claim 12, wherein the first and second sharpness amounts are defined by an edge image or a characteristic point.

16. (Original) An pose estimation method for performing object pose estimation by comparing an input image with a three-dimensional object model, the method comprising:

generating at least one pose candidate;

generating, according to the pose candidate, a plurality of comparison images close to the input image, while projecting the three-dimensional object model to a two-dimensional image;

extracting a first sharpness amount reflecting the sharpness from each of the plurality of comparison images; and

calculating a plurality of weighted differences by weighting the first sharpness amount to the difference between the input image and each of the comparison images.

17. (Original) The pose estimation method according to Claim 16, further comprising:

extracting a second sharpness amount reflecting the sharpness from the input image,

wherein a plurality of weighted differences are calculated by weighting the difference between the second sharpness amount of the input image and the first sharpness amount of each of the comparison images to the difference between the input image and the comparison image in the calculation of the weighted differences.

18. (Previously presented) An pose estimation and comparison method employing the pose estimation method according to Claim 16, further comprising:

selecting a comparison image having the smallest weighted difference among the plurality of weighted differences; and estimating an optimal pose based on the selected comparison image.

19. (Previously presented) An pose estimation and comparison method employing the pose estimation method according to Claim 17, further comprising:

selecting a comparison image having the smallest weighted difference among the plurality of weighted differences; and estimating an optimal pose based on the selected comparison image.

20. (Original) An object difference calculation method for comparing an input image with an object model, comprising:

generating a plurality of comparison images close to the input image based on the object model;

extracting a first sharpness amount reflecting the sharpness from each of the plurality of comparison images; and

calculating a plurality of weighted differences by weighting the first sharpness amount to the difference between the input image and each of the comparison images.

21. (Original) The object difference calculation method according to Claim 20, further comprising:

extracting a second sharpness amount reflecting the sharpness from the input image;

wherein a plurality of weighted differences are calculated by weighting the difference between the second sharpness amount of the input image and the first sharpness amount of each of the comparison images to the differences between the input image and the comparison image in the calculation of the weighted differences.

22. (Previously presented) An object comparison method employing the object difference calculation method according to Claim 20, further comprising:

performing comparison by comparing the plurality of weighted differences obtained by the calculation.

23. (Previously presented) An object comparison method employing the object difference calculation method according to Claim 21, further comprising:

performing comparison by comparing the plurality of weighted differences obtained by the calculation.

24. (Previously presented) An pose estimation program causing a computer to execute object pose estimation by comparing an input image with a three-dimensional object model, the object pose estimation comprising:

pose candidate decision processing for generating at least one pose candidate;

comparison image generation processing for generating, according to the generated pose candidate, a plurality of comparison images close to the input image, while projecting the three-dimensional object model to a two-dimensional image;

first sharpness extraction processing for extracting a first sharpness amount reflecting the sharpness from each of the plurality of comparison images;

weighted difference calculation processing for calculating a plurality of weighted differences by weighting the first sharpness amount to the difference between the input image and each of the comparison images; and

pose estimation processing for selecting a comparison image having the smallest weighted difference among the plurality of weighted differences and estimating an optimal pose based on the selected comparison image.

25. (Original) The pose estimation program according to Claim 24, the object pose estimation further comprising:

second sharpness extraction processing for extracting a second sharpness amount reflecting the sharpness from the input image,

wherein the weighted difference calculation processing calculates a plurality of weighted differences by weighting the difference between the second sharpness amount of the input image and the first sharpness amount of each of the comparison images to the difference between the input image and the comparison image.

26. (Previously presented) An pose estimation and comparison program employing the pose estimation program according to Claim 24,

wherein object comparison is further performed in the pose estimation processing by comparing the smallest weighted difference of the estimated optimal pose with a predetermined threshold value.

27. (Previously presented) An pose estimation and comparison program employing the pose estimation program according to Claim 25,

wherein object comparison is further performed in the pose estimation processing by comparing the smallest weighted difference of the estimated optimal pose with a predetermined threshold value.

28. (Original) A comparison program causing a computer to execute object comparison by comparing an input image with an object model, the object comparison comprising:

comparison image generation processing for generating a plurality of comparison images close to the input image from the object model;

first sharpness extraction processing for extracting a first sharpness amount reflecting the sharpness from each of the plurality of comparison images;

weighted difference calculation processing for calculating a plurality of weighted differences by weighting the first sharpness amount to the difference between the input image and each of the comparison images; and

comparison processing for performing comparison by comparing the plurality of weighted differences obtained by the calculation.

29. (Original) The comparison program according to Claim 28, the object comparison further comprising:

second sharpness extracting processing for extracting a second sharpness amount reflecting the sharpness from the input image,

wherein the weighted difference calculation processing calculates a plurality of weighted differences by weighting the difference between the second sharpness amount of the input image and the first sharpness amount of each the comparison images to the difference between the input image and the comparison images.

30. (Previously presented) An object pose/illumination estimation method for estimating at least one of the pose and the illumination conditions of an object by generating a two-dimensional image of the object while changing at least one of the pose and the illumination conditions of the object with the use of a three-dimensional model of the object, and comparing the generated two-dimensional image with an input image to find a similarity therebetween,

wherein sharpness of the generated two-dimensional image is reflected in the similarity.

31. (Previously presented) An object pose/illumination estimation system comprising:

an image generation unit for generating a two-dimensional image of an object while changing at least one of the pose and the illumination conditions of the object with the use of a three-dimensional model of the object;

an extraction unit for extracting sharpness from the generated two-dimensional image;

a calculator for calculating the similarity by comparing the generated two-dimensional image with an input image, while reflecting the extracted sharpness in the calculation; and

a determination unit for estimating at least one of the pose and the illumination conditions based on the calculation result of the calculator.

32. (Previously presented) An object pose/illumination estimation program for causing a computer to execute estimation of at least one of the pose and the illumination conditions of an object, the estimation comprising:

image generation processing for generating a two-dimensional image of the object while changing at least one of the pose and the illumination conditions of the object with the use of a three-dimensional model of the object;

extraction processing for extracting sharpness from the generated two-dimensional image;

calculation processing for calculating the similarity by comparing the generated two-dimensional image with an input image, while reflecting the extracted sharpness in the calculation; and

estimation processing for estimating at least one of the pose and the illumination conditions based on the result of the calculation processing.

33. (Currently amended) The [[An]] object pose/illumination estimation method according to claim 30, ~~for estimating at least one of the pose and the illumination conditions of an object by generating a two-dimensional image of the object while changing at least one of the pose and the illumination conditions of the object with the use of a three-dimensional model of the object, and comparing the generated two-dimensional image with an input image to find a similarity in brightness therebetween,~~

wherein, if the two-dimensional image having the highest similarity in brightness is not ~~clear~~, sharp the estimation to the input image is not employed.

34. (Currently amended) [[An]] The object pose/illumination estimation system according to claim 31, ~~comprising~~:

~~an image generation unit for generating a two-dimensional image of an object while changing at least one of the pose and the illumination conditions of the object with the use of a three-dimensional model of the object;~~

~~an extraction unit for extracting sharpness from the generated two-dimensional image;~~

~~a calculator for finding the similarity in brightness by comparing the generated two-dimensional image with an input image; and~~

~~a determination unit for estimating at least one of the pose and the illumination conditions based on the calculation result of the calculator~~,

wherein, if the two-dimensional image having the highest similarity in brightness is not sharp ~~clear~~, the determination unit does not employ the estimation to the input image.

35. (Currently amended) [[An]] The object pose/illumination estimation program according to claim 32, ~~for causing a computer to execute estimation of at least one of the pose and the illumination conditions of an object, the estimation comprising:~~

~~image generation processing for generating a two-dimensional image of the object while changing at least one of the pose and the illumination conditions of the object with the use of a three-dimensional model of the object;~~

~~extraction processing for extracting sharpness from the generated two dimensional image;~~

~~calculation processing for finding the similarity in brightness by comparing the generated two-dimensional image with an input image; and~~

~~determination processing for estimating at least one of the pose and the illumination conditions based on the result of the calculation processing,~~

wherein, if the two-dimensional image having the highest similarity in brightness is not sharp ~~clear~~, the determination processing does not employ the estimation to the input image.

36. (Previously presented) An object pose/illumination estimation method for estimating at least one of the pose and the illumination conditions of an object by generating a two-dimensional image of the object while changing at least one of the pose and the illumination conditions of the object, comparing the generated two-dimensional image with an input image to find a similarity therebetween,

wherein sharpness of the generated two-dimensional image is reflected in the similarity.

37. (Previously presented) An object pose/illumination estimation system comprising:

an image generation unit for generating a two-dimensional image of an object while changing at least one of the pose and the illumination conditions of the object;

an extraction unit for extracting sharpness from the generated two-dimensional image;

a calculator for calculating the similarity by comparing the generated two-dimensional image with an input image, while reflecting the extracted sharpness in the calculation; and

a determination unit for estimating at least one of the pose and the illumination conditions based on the calculation result of the calculator.

38. (Previously presented) An object pose/illumination estimation program for causing a computer to execute estimation of at least one of the pose and the illumination conditions of an object, the estimation comprising:

image generation processing for generating a two-dimensional image of the object while changing at least one of the pose and the illumination conditions of the object;

extraction processing for extracting sharpness from the generated two-dimensional image;

calculation processing for calculating the similarity by comparing the generated two-dimensional image with an input image, while reflecting the extracted sharpness in the calculation; and

estimation processing for estimating at least one of the pose and the illumination conditions based on the result of the calculation processing.

39. (Currently amended) [[An]] The object pose/illumination estimation method according to claim 36, ~~for estimating at least one of the pose and the illumination conditions of an object by generating a two-dimensional image of the object while changing at least one of the pose and the illumination conditions of the object, and comparing the generated two-dimensional image with an input image to find a similarity in brightness therebetween~~,

wherein, if the two-dimensional image having the highest similarity in brightness is not sharp ~~clear~~, the estimation to the input image is not employed.

40. (Currently amended) The [[An]] object pose/illumination estimation system according to claim 37, ~~comprising~~:

~~an image generation unit for generating a two-dimensional image of an object while changing at least one of the pose and the illumination conditions of the object~~;

~~an extraction unit for extracting sharpness from the generated two-dimensional image~~;

~~a determination unit for estimating at least one of the pose and the illumination conditions based on the calculation result of the calculator~~,

wherein, if the two-dimensional image having the highest similarity in brightness is not sharp ~~clear~~, the determination unit does not employ the estimation to the input image.

41. (Currently amended) [[An]] The object pose/illumination estimation program according to claim 38, ~~for causing a computer to execute estimation of at least one of the pose and the illumination conditions of an object, the estimation comprising:~~

~~image generation processing for generating a two-dimensional image of the object while changing at least one of the pose and the illumination conditions of the object~~;

~~extraction processing for extracting sharpness from the generated two-dimensional image~~;

~~calculation processing for calculating the similarity in brightness by comparing the generated two-dimensional image with an input image~~;

~~determination processing for estimating at least one of the pose and the illumination conditions based on the result of the calculation processing~~,

wherein, if the two-dimensional image having the highest similarity in brightness is not clear, the determination processing does not employ the estimation to the input image.

42. (Previously presented) An object illumination estimation method for estimating an illumination condition of an object by generating an image of the object with the use of a plurality of images of the object different in illumination conditions, and comparing the generated image with an input image to find a similarity therebetween,

wherein sharpness of the generated image is reflected in the similarity.

43. (Previously presented) An object illumination estimation system comprising;

an image generation unit for generating an image of an object with the use of a plurality of images of the object different in illumination conditions;

an extraction unit for extracting sharpness from the generated image;

a calculator for calculating the similarity by comparing the generated image with an input image, while reflecting the extracted sharpness in the calculation; and

a determination unit for estimating an illumination condition based on the calculation result of the calculator.

44. (Previously presented) An object illumination estimation program for causing a computer to execute estimation of an illumination condition of an object, the estimation comprising:

image generation processing for generating an image of the object with the use of a plurality of images of the object different in illumination conditions;

extraction processing for extracting sharpness from the generated image;

calculation processing for calculating the similarity by comparing the generated image with an input image, while reflecting the extracted sharpness in the calculation; and

estimation processing for estimating an illumination condition based on the result of the calculation processing.

45. (Currently amended) [[An]] The object illumination estimation method according to claim 42, ~~for estimating an illumination condition of an object by generating an image of the object with the use of a plurality of images of the object different in illumination conditions, and comparing the generated image with an input image to find a similarity in brightness therebetween,~~

wherein, if the generated image having the highest similarity in brightness is not ~~clear~~ sharp, the estimation to the input image is not employed.

46. (Currently amended) [[An]] The object illumination estimation system according to claim 43, ~~comprising~~:

~~an image generation unit for generating an image of an object with the use of a plurality of images of the object different in illumination conditions;~~

~~an extraction unit for extracting sharpness from the generated image;~~

~~a calculator for finding the similarity in brightness by comparing the generated image with an input image; and~~

~~a determination unit for estimating an illumination condition based on the calculation result of the calculator,~~

wherein, if the generated image having the highest similarity in brightness is not ~~clear~~ sharp, the determination unit does not employ the estimation to the input image.

47. (Currently amended) [[An]] The object illumination estimation program according to claim 44, ~~for causing a computer to execute estimation of an illumination condition of an object, the estimation comprising~~:

~~image generation processing for generating an image of the object with the use of a plurality of images of the object different in illumination conditions;~~

~~extraction processing for extracting sharpness from the generated image;~~

~~calculation processing for finding the similarity in brightness by comparing the generated image with an input image; and~~

~~determination processing for estimating an illumination condition based on the result of the calculation processing~~,

wherein, if the generated image having the highest similarity in brightness is not ~~clear~~ sharp, the determination processing does not employ the estimation to the input image.